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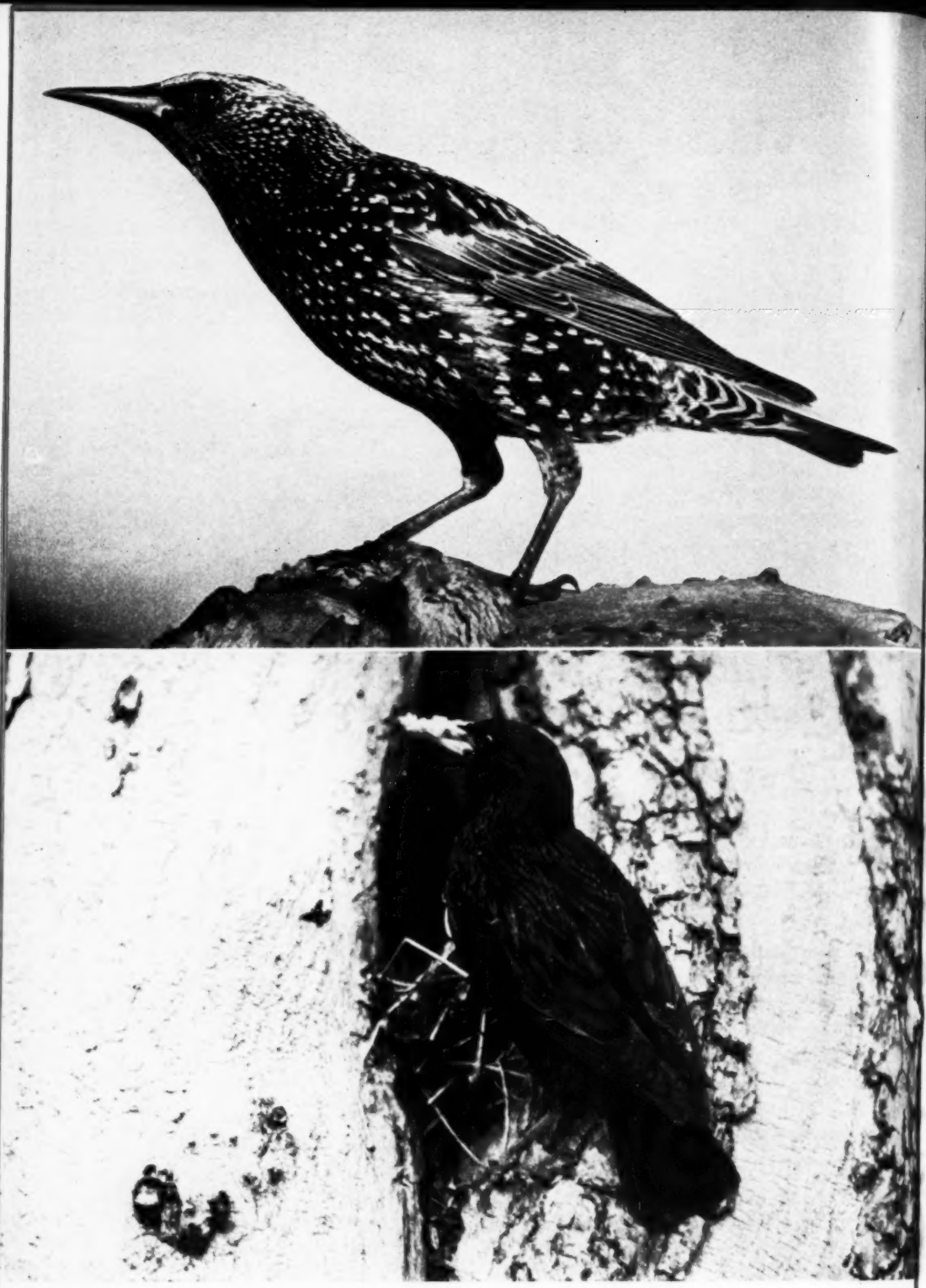

STARLING IN RECENTLY ACQUIRED FALL PLUMAGE (upper)
AND IN THE WORN SPRING PLUMAGE (lower)

Allan Cruickshank
National Audubon So

A REVIEW OF EXPERIMENTAL INVESTIGATIONS ON SEASONAL REPRODUCTION IN BIRDS

J. WENDELL BURGER

Trinity College, Hartford, Conn.

MANKIND has known for centuries that domestic hens could be made to lay more eggs in winter by putting lights in the coops at night. Known also have been certain photoperiodic manipulations (Miyazaki, 1934), (Hoos, 1937) through which caged birds could be induced to sing unseasonably. Despite the considerable work which has been done with poultry, the accumulated knowledge concerning photoperiodism in plants, experiments dealing with the effect of light upon plumage (Beebe, 1908), and various theorizings concerning the effect of light upon the annual cycle in animals (Schaefer, 1907, and others), the experimental study of seasonal reproduction has not been attempted until very recently. The work was initiated in 1925, by Rowan, who was interested primarily in migration, and expanded by Bissonnette in 1930.

Rowan's chief finding was that precocious spermatogenesis could be brought about in sexually inactive male Juncos by adding several hours of artificial illumination to natural winter day lengths. Bissonnette, working with the Starling, confirmed Rowan's findings. (For summaries of the avian studies carried on by these two workers, see Rowan, 1938 and Bissonnette, 1937.) The basis for this work was the frequently observed correlation between increase in gonad-size and lengthening of days in spring. This shift in the proportion of daylight-hours to darkness-hours has been known as long as mankind has been aware of the equator, the poles, and the season. The difference between the total of daylight hours on the longest and shortest days of the year is least at the equator and greatest at the poles. Baker (1938b) graphs the day lengths at various seasons and latitudes.

From Rowan's and Bissonnette's observations has arisen the generalization that increase in day lengths induces spring gametogenesis in birds. Much of the work of the past 20 years has tested the validity of this generalization. Rowan himself, on the basis of earlier experiments with the exercising of birds, came to the conclusion that lengthening of days had no direct photic influence upon the gonads, but that it did permit the birds to exercise more. Wolfson (1941) perceived a correlation between degree or incidence of wakefulness and increase in day length and in gonad size. No experiment thus far devised has proven that any external stimulus, *operating in darkness*, induces precocious gametogenesis.

Gonadotropins secreted by the pituitary are believed to stimulate the gonads, release sex hormones, and cause gametogenesis. The release of sex hormones is closely correlated with the development of the reproductive organs, of secondary sexual characters, of some sexually dimorphic characters, and of behavioral

patterns. Reproductive rhythmicity may be, basically, hypophyseal rhythmicity; the activity of the adult gonad merely a reflection of hypophyseal activity. What is it, then, that controls the avian pituitary? The bald answer is that no one knows. What we do know indicates that external environment determines the activity of the pituitary at least to some extent.

We must never lose sight of the fact that the environment of the many species of birds varies widely. What is true of one species may not be at all true of another. We are justified in talking about 'the bird' only when we have learned, through patient observation, that the several species, races, and individuals which we are discussing behave uniformly. Unfortunately, the field naturalist and the laboratory worker often do not understand each other. The one complains that factors operating on the bird in the laboratory are very different from those operating on the bird in a wild state; that results obtained through laboratory observations do not *prove* anything about the wild bird. The laboratory worker, on the other hand, is justified in maintaining that tests, observations, and experiments carried on in the laboratory can and do lead to important and significant discoveries. Environmental factors which may seem of great importance to the field worker may, when tested carefully, prove to be of little significance.

It is unfortunate and regrettable that so little work is being done today in the tropics and the southern hemisphere; and that there is no such thing as a correlated study of trans-equatorial migrants such as might be carried on were the ornithologists of South America, Africa, and Australia organized for collaborating with ornithologists of the northern hemisphere. What little we know —and it is fragmentary knowledge at best—has to do principally with birds of the North Atlantic area and of western North America.

The following review of the literature is not by any means the equivalent of a complete bibliography. I have made a point of discussing at some length the most important papers which have appeared, but unimportant papers I have not even mentioned. With a few exceptions, I have consulted all references while preparing the manuscript. I wish to thank T. H. Bissonnette for the use of his personal library and for his counsel during our association at Trinity College. I wish also to thank E. E. Bailey for his help. My work has been supported largely by grants from the Penrose Fund of the American Philosophical Society.

Seasonal Reproduction

The studies of Baker (*vide* Baker, 1938b) form an important survey of the seasonal factors that are present throughout the world. Baker's generalizations are sufficiently important to quote verbatim (p. 578):

1. As one goes north from the temperate latitudes one finds a general tendency for the egg-laying seasons of birds of all kinds to start later and later at the rate of some 20 or 30 days per 10° of latitude.

2. As one goes south from the temperate latitudes into the northern tropical and equatorial zones one finds a general tendency for the Accipitres, Coraciiformes, and, to a less extent, the Passeres, to start their egg-laying earlier and earlier.

3. The Charadriiformes, Grallae, Herodiones, and Anseres behave differently. In the northern hemisphere they tend to breed later in the tropical and equatorial zones than in the subtropical and temperate.

4. There is a general tendency for birds in the tropics to reach the height of their main breeding seasons somewhat before the sun passes overhead. Two breeding seasons in the year are therefore quite common, but birds which breed only once select either the northward (Accipitres, etc.) or southward (Grallae, etc.) swing of the sun.

5. The main proximate causes of the breeding seasons of birds in nature are thought to be temperature and length of day in the boreal and temperate zones, and rain and/or intensity of insolation near the equator. The time of arrival from migration is often an important factor.

6. Much egg-laying occurs when days are getting shorter, and indeed it often proceeds rapidly while they are decreasing in length and only between 11 and 12 hours long.

7. There is, however, little egg-laying when the day is shorter than 11 hours, and almost none when it is less than 10.

8. Under natural conditions birds exhibit no tendency to start breeding everywhere when the days reach a certain length nor when they are becoming longer particularly quickly.

Baker (1937) states that not many equatorial birds are known to breed all the year round, despite almost uniform length of day. These generalizations of Baker indicate the need for world-wide testing under controlled conditions. Moreau, Wilk, and Rowan (1947) have studied the males of 3 species of birds at 5° south of the equator. In all 3 species, the testes were largest between September and March; smallest in the following cooler and rainy season; and became larger when day lengths were increasing by only 20 seconds per day.

Reproduction must first have a genetic basis. While the domestic fowl is in many ways not like wild birds, poultry breeding does demonstrate that reproduction can be modified by genetic factors. Through genetic selection, strains that lay eggs for long periods, that continue to lay despite molt, that have lost broodiness, etc. have been developed. Riddle, Smith, and Benedict (1932) crossed a South American dove, *Zenaidura auriculata vinaceo-rufa*, which breeds the year round in captivity at New York (when protected from cold), with the Mourning Dove, *Zenaidura macroura*, which in captivity breeds only between April and August. The hybrids were intermediate between the parents, i.e. the testes were not reduced in the fall as much as in the *auriculata* parent. Bullough's (1942) studies of the Starling indicate that in Great Britain there are 2 races, a Continental and a British. The Continental race has a longer period of gonadal inactivity; and so-called out of season breeding occurs only in the British race. Among other intra-specific differences might be mentioned the fat deposition (light affected) of resident and migratory forms. This fat deposition does not occur in a non-migrant such as the English Sparrow (Wolfson, 1947). These differences point to the need for considering genetic differences when one compares individuals of a species from different localities.

Attention may be focused too narrowly on the environmental alone. When a group of birds is introduced into a new locality, one should consider the possibility that selection may alter the reproductive pattern.

Baker and Ranson (1938), who have collected a great deal of information on the reproductive rhythms of southern hemisphere birds moved into the northern hemisphere, find that most birds change to the equivalent season. The Australian Black Swan, however, changes from a restricted breeding season to breeding at any time of the year in the northern hemisphere. A few birds (Northern Rosella Parrot, Gouldian Finch, Budgerygah) tend to retain their original southern hemisphere periodicity in the northern hemisphere.

Baker (1938a) has tabulated the egg laying periods for Old World birds. The breeding season of the Starling introduced south of the equator into New Zealand extends from August to December instead of from April to June (as in Britain or Germany). The English Sparrow breeds principally from May to August in Britain, but from August to December in New Zealand. Baker's tables show that the English Sparrow breeds the year round in Ceylon and Great Britain, but not in Germany or subtropical northern India.

A fascinating case is discussed by Davis (1945). Several Silver Gulls (*Larus novae-hollandiae*) were moved from Australia to a zoo in the United States. For 2 years the birds nested in November, following their original custom, then changed to nesting in spring and early summer. After 20 years of captivity, their descendants reverted to a fall and winter breeding. Murphy (see Bissonnette, 1937) found that European Storks confined to Lima, Peru, bred below the equator at the time when they would have bred north of the equator.

A much quoted example is the observation of Witschi (1936) that the Orange Bishop, *Euplectes franciscana*, an African weaver finch, maintained its original timing of the plumage cycle when confined in Iowa. Brown and Rollo (1940) and Rollo and Domm (1943) have shown that this species' plumage cycles and testicular states are modifiable by photoperiodic manipulations. Thirteen to 14 hours with 126 foot-candles of illumination were found to be optimum for the production of nuptial plumage. Thus, an apparently inflexible rhythm proves to be flexible when analyzed experimentally. Friedmann (1937, p. 423) says that two races of *Euplectes franciscana*, found respectively in Ethiopia and the Sudan, have different breeding periods.

Even birds that breed the whole year round, such as the Brown Booby in the Cape Verde Islands (Baker and Ranson, 1938), tend to have 1 or 2 breeding periods in a year. So far as is known, no wild bird has equal reproductive vigor at all seasons; and in no wild species does reproduction occur independently of external influences. The common pigeon breeds almost continuously on farms, but it has smaller gonads in the fall and is depressed reproductively by cold (Riddle 1925, 1938).

The domestic fowl also breeds more or less continuously but it, too, is influenced by the environment. The large literature on the fowl is somewhat obscured by the preoccupation with problems of poultry management. It would be most instructive if the less 'domesticated' breeds were investigated thoroughly. Semen production in the fowl is highest from about November to May and lowest for the rest of the year (Parker and McSpadden, 1942, Wheeler and Andrews, 1943). Jones and Lamoreux (1942) have reported that strains bred for high fecundity mature more rapidly and produce more sperm than do less fecund strains. David (1938) found that injection of androgen induced a seasonal comb growth. (In capons combs may be twice as sensitive to androgen in the winter as in the summer.)

In only a few species of birds is the inherent reproduction rhythm relatively inflexible; and, as has been shown to be the case in *Euplectes*, this inflexibility may not be real. Effect of environment on the labile internal reproductive machinery appears to determine the breeding period for each species. Both the internal cycle and the environment are variables. For example, the Starling on the Atlantic coast breeds about a month later in the Gaspé region (Ball, 1945) than in Hartford, Connecticut or Ohio (Hicks, 1933). This is less than 10° of latitude and fits the generalization of Baker (see above). However, the breeding time in Connecticut and in Great Britain (Bullough, 1942) is roughly the same despite a difference of about 10° of latitude. The climate of Great Britain resembles that of Connecticut more than it does that of the Gaspé peninsula. The sexual cycle of English Sparrows breeding in the United States (Ringoen and Kirschbaum, 1937) roughly coincides with that of English Sparrows breeding in Russia, presumably near Leningrad (Polikarpova, 1940), with a difference in latitude of about 20°. Linsdale (1933) found that the peak of the breeding season for birds in Kansas came in June, while at a similar latitude in California it came in April and May. He believed this discrepancy to be correlated with rainy periods and availability of food.

Riddle, Smith, and Benedict (1932) found that the conditions of captivity gave the Mourning Dove a slightly longer than natural breeding period. Rowan (1929) found that the canary, a subtropical bird with protracted breeding season, exhibited pronounced sexual behavior in captivity in winter in Canada. Male canaries which were not lighted at night had larger testes and were more active sexually than captive native Juncoes.

Experimental Stimulation of Gonads

While the goal of reproduction is the production of viable young, a study of fertile matings may not reveal the factors involved in securing this result. Most of the experimental work has dealt with the male. The female as such, and the reciprocal relationships of the sexes have received little attention. Most

studies, furthermore, have been concerned with the factors inducing gametogenesis. The factors involved in inducing and maintaining the non-breeding condition are less well known.

Tests indicate that all birds that breed seasonally are responsive to photoperiodic manipulations. Scott and Payne (1937) got no response from the guinea fowl. More recently, however, Davis and Penquite (1942) got a slight testicular response (no sperm) through exposing male guineas to continuous light (begun January 31).

The basic test consists in giving sexually quiescent, non-refractory birds a daily period of artificial light added to natural day lengths, or by making an artificial day solely by artificial light. Sperm is produced usually in this way in about 1 month.

Activity and Wakefulness. As a result of his early experiments with the Junco, Rowan (1929, 1938) believed that exercise (and later the general activity resulting from the longer days) acted as the primary stimulus for gonadal activation. Wolfson (1941) modified Rowan's theory to read, "As the days increase in length, birds are awake for longer periods of time because the state of wakefulness, at least in some birds, is a conditioned response to light; the concomitant activity of the hypothalamus causes an increased production or release, or both, of the gonadotropic hormones from the anterior lobe of the pituitary; these, in turn, stimulate gonadial recrudescence." Wolfson reported no original avian work to confirm his speculations.

Bissonnette (1931a, 1937) using Rowan's technique, was unable to confirm Rowan. Riley (1940), and Kendeigh (1941) rotated English Sparrows in drum-like cages in darkness. The daily period of rotation corresponded in length to the usual added period of illumination. No gonadal stimulation resulted from this enforced activity and wakefulness in darkness. Thornton and Cummings (1945) gave (in darkness) an added period of noise as a supplement to short days, and found no gonadal stimulation with the English Sparrow. Benoit (Benoit and Ott, 1944) immobilized ducks, and secured a response to light. Burger, Bissonnette, and Doolittle (1942) kept Starlings awake with flashing light. They could produce stimulation or no stimulation by varying the length of the flashes and the intervals of darkness between the flashes. Strangely enough, the demonstrated fact that, for some species, the blue end of the visible spectrum fails to activate males, has not been mentioned in various arguments. Wolfson (1941) in his long critical paper fails to mention this type of evidence. Starlings subjected to long "days" of blue light act as though they are awake; they feed, bathe, etc. (Burger, 1943). Miyazaki (1934) first noted that captive birds subjected to artificially long days were very quiet and drowsy, though activated sexually.

Whatever the ultimate solution of this problem, the exercise-activity-wakefulness theories, as currently phrased, are clearly inadequate. Thus far, no ex-

ternal environmental stimulus except light has been *shown* to induce complete spermatogenesis in seasonally reproducing birds.

Food. Perry's report (1938) that irradiated food activated English Sparrows sexually was not confirmed by Kirschbaum, Pfeiffer, Van Heuverswyn, and Gardner (1939), or by Perry himself. Bissonnette (1931b) found that Starlings with low protein diet did not respond sexually even when the days were long. Kendeigh (1941) noticed no difference in testicular stimulation in English Sparrows if food was given in restricted periods or over the whole light-period. Birds ate as much food in the first instance as in the latter, but in less time. The relation of food to natural reproduction is not easy to determine. Kendeigh (1941) wrote, "The energy demands for full development of the testes and partial development of the ovaries appear not to be large. . . . The final and complete formation and laying of eggs, however, requires considerable energy output". This is well recognized in poultry.

Temperature. External temperature has no *prohibitive* effect in most birds tested. Rowan's original work was done at subzero temperatures. Bissonnette and Csech (1937) induced pheasants to lay eggs in a snow bank. Kendeigh (1941) compared temperatures of 72° F. with 36° F. for effect on the English Sparrow, and noticed no difference in response. Outdoor weather in Kansas did not depress the breeding of turkeys (Scott and Payne, 1937). Schildmacher (1938) secured testicular activation with *Phoenicurus* at temperatures around 0° F. Suomalainen (1937) found no difference in response to light between one lot of *Parus major* kept at an average temperature of 1.9° C. and another kept at an average of 20° C.

Reproduction in pigeons is depressed by cold (Riddle, 1925). Kendeigh (1941) found that clutch size and egg size of the House Wren were correlated with temperature. A temperature of 67°F. was correlated with more and larger eggs than one of 77°F. Lee, Robinson, Yeates, and Scott (1945) reported that high temperature reduced egg laying among domestic hens in Australia to about once a week. Many eggs were soft and deformed. Some increase occurred even though the heat was maintained. There was found also a difference among breeds in susceptibility to heat. Laying was not abolished entirely. One must distinguish, however, between effects on seasonal reproduction as a whole, and effects on individual ovulations and clutch formation. In the latter 2 examples, clutch formation, rather than the ability to breed at all are influenced. In nature, the ornithologist mostly sees clutch formation or its lack, but does not know more about the ovary.

Burger (1948) found that Starlings kept under conditions of long days and relatively constant temperatures of 90° to 100° F. had testes far larger than those developed in the same time by birds kept under cooler fluctuating temperatures. These warm temperatures, however, did not induce progressive spermatogenesis under short days. The significance of these results is not clear. These

temperatures are higher than those experienced by the Starling for any great time during the normal breeding season. The results do demonstrate that external temperatures approaching the Starling's body temperature do not suppress spermatogenesis nor cause testicular involution.

At Hartford, Connecticut, the winter of 1947-8 was much more severe than that of 1948-9. In early spring of 1948, testicular enlargement occurred in wild Starlings despite the presence of snow on the ground for the preceding 3 weeks and a mean daily temperature of about 30° F. In the milder 1949, testes secured on the same date as those of 1948 were only slightly larger. It is highly desirable that a study be made over a period of several years at different latitudes or for different conditions for a given species, in which both testes and ovaries are studied at different periods in the cycle. Records of nesting times alone do not tell whether the whole breeding complex is delayed, say by cold weather, or whether only a phase is delayed.

Photoreception. The conventional view is that light is received by the eye which sets off an unknown sequence of events terminating in stimulation of the pituitary. It now appears that stimulation of the pituitary is not effected by nerve fibers going to the anterior lobe via the stalk. Drager (1945) found in the chick no fibers from the stalk going to the anterior lobe. Bissonnette and collaborators (unpublished) have cut the pituitary-stalk of ferrets (a mammal) without loss of sexual activation induced by long days. Many data of this type show that the hypothalamus is involved in mammals.

Considerable evidence indicates that the eye is the primary receptor. For example, hooding the head prevented light from effecting stimulation in 6 of 9 English Sparrows (Ringoen and Kirschbaum, 1939). The 3 that showed response were assumed not to have had tight hoods. Hooded immature ducks did not respond to light until an opening was made in the hoods (Benoit and Ott, 1944). Ivanova (1935) got in the English Sparrow no suppression of spermatogenesis by hoods; she considers the plucked skin (Ivanova, 1935) as a possible receptor for light. Benoit got no response by illuminating the plucked skin, while Ringoen and Kirschbaum (1939) do not confirm Ivanova's hooding experiment.

Benoit (see Benoit and Ott, 1944 for a summary and bibliography) achieved spectacular results in a long series of experiments on immature ducks. He found that light induced spermatogenesis when: 1) the optic nerve was cut but the eyeball remained in the socket; 2) the eyeball was removed and the orbit illuminated; 3) the hypophysis was illuminated directly by a narrow beam of light; and 4) parts of the rhinencephalon and hypothalamus were illuminated by a narrow beam of light. Gonadal response was slight when blue light was used and the eye kept intact, but when the eye was removed and the hypophysis was illuminated directly with blue light, marked gonadal response occurred. Benoit considered the hypophysis to be stimulated by a dual system: 1) an

oculo-hypophyseal system, and 2) an encephalo-hypophyseal system. He believed that both systems are able to function at the same time, i.e. light could stimulate the eye proper and, by penetration of the head, stimulate deeper areas. By illuminating with strong light, half a duck's head, placed on photographic paper, Benoit found that light could penetrate to the pituitary. The penetration was best with red rays, the rays that in the normal duck are the best activators of spermatogenesis. The different effects on the intact bird of various wave lengths of light (see below) would be explained as due to a differential absorption by the tissues of the various wave lengths. Photostimulation is not considered entirely dependent on color vision.

Wave length. Bissonnette (1932a) and Burger (1943) using Starlings, Scott and Payne (1937) using turkeys, Benoit and Ott (1938, 1944) using ducks, find that the blue end of the spectrum stimulates the gonads little if at all. Benoit and Ott (1944), and Burger (1943) agree that the far-red and near infrared are not stimulatory. The most effective wave lengths lie in the yellow-red. Burger (1943) places the wave lengths that will induce sperm in the Starling, approximately between 0.58 and 0.68 microns. There is no evidence that ultra-violet is stimulating or necessary. All investigators, except Rowan (1938) find different effects by different wave lengths within the visible (human) spectrum. Details of Rowan's experiments do not seem to be published.

Light Intensity. The influence of light intensity has been investigated. Burger (1939b) found that when Starlings were subjected to a constant 10.5 hour artificial day, a gradual increase in intensity from Mazda lamps from 25 watts to 500 watts produced no spermatogenesis. Intensity of illumination did not substitute for adequately long lengths of day. Bissonnette (1931b *et. seq.*) first tested intensity in a coherent manner. With long days, Mazda lamps were effective on Starlings in the following order of wattage: $10 < 15 < 25 <= 40 = 50 = 60$. When a sunlamp was equated with a 200 watt Mazda lamp for luminous intensity, and a 1000 watt lamp equated with the 200 watt lamp for heat intensity, the 200 watt lamp was the more effective. Bissonnette (1932a) found that 1.7 foot-candles of filtered red light was sufficient to induce complete spermatogenesis. The minimum intensity has not been established, but an unmeasured faint light did not stimulate spermatogenesis. On figures given for the domestic fowl (Dobie, Carver, Roberts, 1946) no difference in egg production was found with intensities between 1 and 31 foot-candles.

One rather obvious fact about comparative measurements of intensity seems to be not clearly recognized. Since one may secure a differential effect because of wave length, and since spectral distributions vary with different lamps and intensities, comparative data can only be accurate if monochromatic bands are used. Furthermore, no one has tested the possible significance of a source of light from a single bright source such as a Mazda lamp in comparison with a light that is diffuse.

Bartholomew (1949) working with English Sparrows found that in the fall, 10 foot-candles are less effective than 200 foot-candles from "Daylight Fluorescent Lamp". In the winter however, 10 foot-candles were as effective as higher intensities. Ten foot-candles were more effective than lower intensities. A low intensity of 0.7 f.c. induced sperm in 46 days, while a still lower intensity, 0.04 f.c. was only one-tenth as effective as 0.7 f.c. Relatively low and moderate intensities seemed sufficient to induce complete spermatogenesis, but the rate of response, increased with an increase in intensity. Very faint light, did not, however, induce spermatogenesis, and high intensities were not increasingly effective. One might expect an increase in effectiveness with high intensities due to an increased cranial penetration, if Benoit's theory holds.

Length of Day. Since both intensity of light and wave length vary, and since natural days vary not only in length but also in intensity of light and wave length, experimental work of a quantitative nature should be done under standard conditions. These conditions have not been defined. Each worker has made his own conditions, so most quantitative data in the literature are really qualitative.

Burger (1940) concluded that the minimum day length required by the Starling for the *rapid* production of sperm was slightly less than 12.5 hours. Days of 10.5 hours induced spermatogonial multiplication only. Rollo and Domm (1943) found 13–14 hours optimal for inducing nuptial plumage in the weaver finch, *Euplectes fanciscana*. With poultry, the usual long day administered is 13–14 hours. Bartholomew (1949) secured some interesting data on the English Sparrow. Judging by rate of activation, he found that winter days of 12 and 14 hours were as effective as days of 16 and 24 hours. With days only 10 hours long he was able to secure sperm in 46 days in his 2 experimental sparrows. These 2 birds had previously served as controls for another experiment where they were on days of 8 hours. In another of his experiments (p. 444) one of 2 controls kept on an 8-hour day had a marked testicular development. It might be profitable to repeat these studies on a larger scale. There seems to be a difference between the English Sparrow and the Starling, since in the Starling 10.5 hours of light caused no progressive activity between Jan. 27 and April 20.

It must be noted again, as has been said by many authors, that as one goes toward the equator, day lengths become less and less variable between the solstices. As Bartholomew (1949) pointed out, day lengths even in the United States may remain longer than necessary to activate the English Sparrow. One phase of this problem may have been clarified by work on the Starling (Burger 1939a, 1939b, 1940). Here spermatogenesis did not occur when day lengths were gradually increased from 6 to 9 hours. Spermatogenesis, however, did occur at no reduced rate when day lengths were gradually reduced from 20.5 hours to 16 hours. It was concluded that spermatogenesis in the Starling is

not induced by an increase or a decrease in day length as such, but because the length of day is reached which is sufficiently long to be stimulating.

Testicular Inactivity and Refractoriness

Most experimental work has dealt with stimulation of the testes. In order to secure stimulation the testes must at first be in an inactive state. Such inactive gonads are found in immature birds and in adult birds in what Polikarpova (1940) quaintly calls the "dead sexual season", i.e. the period of testicular quiescence following a breeding period. The quiescent period of the immature and that of the adult are not entirely homogeneous either when compared to each other and when compared to themselves over a period of months. With the immature bird, one must consider the special problem of maturation. Riley (1936) found that additional light given to adult English Sparrows on September 30, induced no subsequent spermatogenesis. Juveniles, however, did respond. Adults lighted on November 18 did produce sperm. Obviously, between September 30 and November 18, the adults passed from a refractory state to a state where light stimulation was effective. Schildmacher (1938) reported that juvenile *Phoenicurus* became completely stimulated by added light only after October 10, but before October 25. Bissonnette and Csech (1938) present an interesting example of the relation of juvenile maturation and day lengths. Ring-neck Pheasants hatched on Christmas day from eggs precociously secured by photoperiodic manipulations, laid 2 infertile eggs on July 25–26 under natural light conditions. These eggs were laid later than the normal season for adults, in the juveniles' first 7 months of life. Here obviously, maturation had progressed sufficiently for the long days of July to be an effective stimulus. Riddle (1931) found that pigeons and ring-doves mature more slowly when the time of maturity as set by the date of hatching, occurs in the autumn. Maturity is hastened in the period February to July. Chicks of the domestic fowl hatched in summer grow more slowly than chicks hatched in winter, presumably because of a reduced feed consumption during hot weather. Night lighting of chicks improved the rate of growth in the summer (Heywang, 1944) in Arizona.

While adult birds can be activated precociously by long days, this stimulus is unable to keep the testes in a continuous state of spermatogenesis. The gonads involute after an active period, just as they do in nature. The post-breeding involution and sexual quiescence is due not to the absence of an initially effective stimulus. In nature, day lengths are still increasing when the gonads of Starlings involute. An internal refractory state develops, i.e. the bird no longer will remain in or initiate gametogenesis when given long days. This refractoriness must 'wear off' before external stimuli can induce a new gonadal activation. The duration of the refractory period in conjunction with the annual light cycle seems to control the *general* form of the annual reproductive cycle of many birds tested. The refractory state may wear off before day

engths are too short to be completely non-stimulatory. Hiatt and Fisher (1947) found that the Ring-necked Pheasant has a partial sexual activation in the fall (Montana). Witschi (1935) writes, "prolonged Indian summers with sunny days extending until late November bring about precocious development of the testes in free living English Sparrows of Iowa". In general, the refractory period lasts so long that autumn days are too short to induce a complete gametogenesis.

This problem of refractoriness is perhaps the greatest relatively unsolved problem in reproduction. A seeming contradiction to the statements about the importance of the refractory state arises from the fact that many investigators have been able to produce 2 or 3 cycles of spermatogenesis in a year. Rowan (1929) first produced for the Slate Colored Junco, 2 spermatogeneses, one in January and the other in May. Miyazaki (1934) secured 2 cycles with Mejiro (*Zosterops palpebrosa*). Damste (1947) induced 3 cycles in the Greenfinch. Burger (1947) got 2 cycles with the Starling.

Results with the Starling (Burger 1947, Bissonnette, unpublished) seem to resolve this contradiction. In all the above cases, the first additional spermatogenesis was produced by first reducing the day length while an active spermatogenesis was occurring and then later increasing the day length. In the Starling, if day length was reduced just as sperm was being first formed due to long day stimulation, the testes promptly involuted. A second addition of long days induced a new spermatogenesis in all birds. If, however, the first spermatogenesis was allowed to continue until a natural involution set in, then a period of short days followed by another period of long days resulted in a less successful reactivation. If a complete involution, produced naturally, was allowed to develop, then a rest of a month on short days followed again by long days resulted in still less testicular activation. In all cases, however, a period of short days was followed by at least some testicular reactivation when long days were reapplied. Birds kept on long days without a rest on short days went through one testicular cycle and then remained quiescent. When continuous light was given, an initial spermatogenesis occurred, followed by involution. The testes after one spermatogenesis remained quiescent for 15 months after the start of this experiment. If, however, the continuous light was reduced to shorter days and then readministered, a new testicular stimulation took place.

These results indicate that 2 kinds of testicular quiescence occur in the adult. A reduction in day length produces an involution which is not characterized by a refractoriness to long day stimulation. If spermatogenesis is allowed to run its *full course* under long days then a refractoriness to long-day stimulation sets in. This latter refractoriness can be dissipated (at least for the Starling) only by a 'rest' on short days. For the Starling, there seems to be no inherent gonadal rhythm which can act independently of external light changes.

This latter type of testicular quiescence, i.e. that produced under long days, is here designated as true refractoriness.

In the research of Rowan (1929), Miyazaki (1934), and Damste (1947), the extra cycles perhaps occurred only because true refractoriness was not allowed to develop. Short days caused the gonads to involute before true refractoriness was established. It should be emphasized again that the research on the Starling indicates that the refractory phase of the gonadal cycle is influenced by light just as much as is the phase of progressive spermatogenesis.

For the Starling the natural end of refractoriness has not been determined, although it does end before mid-November at Hartford, Conn. Rowan (1929) first noted that the refractory period ends gradually. Riley (1936), confirmed by Kendeigh (1941), found that for adult English Sparrows, the refractory period ended before November 18. Miller (1948) with adult and immature Golden-crowned Sparrows determined the end between November 5 and 20. Wolfson (1945) with Oregon Junco (3 adult and 8 immature) got no response to light begun on October 18. A few White-crowned Sparrows did respond at this time. Rowan (1929) for Slate-colored Juncos got complete spermatogenesis with lighting begun November 1, and a slight response from October 2 lighting. For immature English Sparrows Riley (1936) got stimulation starting at September 30. Miller got no response with the Golden-crowned Sparrow from October 10 lighting. Schildmacher (1938) got sperm in immature *Phoenicurus* only when lighted about October 25, not earlier. Of course, date of hatch must be considered, since early hatched juveniles would be expected to mature before late hatch birds. The above figures indicate for the species mentioned a good deal of similarity for the time of ending the refractory period in the adults.

Miller (1948) continued his lighting until April. He observed that birds that did not respond to long days when tested early in the fall never did show testicular development. Interpreted in the light of our results in the Starling, it would seem that the long days prolonged the refractory period, which had not yet 'worn off'.

It is worthwhile to elaborate further on the results secured by Damste (1947) on the Greenfinch. His birds were activated by natural spring day lengths in the laboratory. In mid-May, before a natural testicular involution occurred, the birds were placed on very short days until August 14, when they were exposed to natural day lengths for that season in Holland. A new spermatogenesis resulted, followed by an involution which began about November 4, and which was completed by early December. In early December, artificial long days were given and a third spermatogenesis induced. These results are explicable in this wise: The 2 involutions were produced by short days, one artificially, the other naturally. These short days prevented true refractoriness from developing. After each involution, the birds were able to respond to longer

days. It is interesting to note that late summer and early fall day lengths are sufficiently long to be stimulating for the Greenfinch, provided the bird is not in a refractory state. To put it another way, some birds do not breed in the late summer because they have bred in the spring. Bissonnette (1937) seems to have been the first to discuss refractoriness as the limiting factor of reproductive periodicity.

Brown and Rollo (1940) kept Weaver Finches in nuptial plumage for more than a year by continuous long days. Rollo and Domm (1943) found that both short days and long days retarded the appearance of nuptial plumage. These findings show that inherent periodicity requires the cooperation of external day lengths. One must remember that plumage cycles and sex cycles are not the same thing. Testicular activation and the appearance of nuptial plumage are more or less congruent in this example.

For the Starling, it seems that day lengths affect the whole seasonal cycle, and do not merely fire an internal mechanism which, once set off, is self-controlling.

The question arises as to how the pituitary is inactivated internally. Miller (1949) demonstrated that the inactive testes of adult and immature Golden-crowned Sparrows could be activated by the injection of pregnant mare serum. This suggests that failure of testicular response is not due to a refractoriness of the testis. Riley and Witschi (1938) found that male English Sparrows responded equally well at all seasons to injected gonadotropin. Females, however, showed a seasonal response to the same treatment.

Witschi and Miller (1938) showed that both sexes of the Starling formed male and female sex hormones. Either or both of these hormones might depress the pituitary. For the domestic fowl, Riley and Fraps (1942) have tentatively suggested that the "gonadotropic content of the pituitary would . . . be inversely proportional to the sex hormone concentration . . . it is probable that the gonadotropic content of the hen's pituitary is influenced by more than one factor." Pfeiffer and Kirschbaum (1941) have suggested that androgen may cause a release of gonadotropic hormone in the female English Sparrow.

Burger (1944, 1945) found that testosterone neither blocked photoperiodic stimulation nor depressed an already activated testis in the male Starling. Estradiol had a disruptive, unnatural effect on the testis, but, when given with testosterone, this effect was abolished. Burger (1947) suggested that the testis does not give off a substance which inhibits the pituitary.

Witschi and Fugo (1940) found that testosterone did not have a depressing effect on the ovary of Starlings. Ringoen (1940) found that theelin had no depressing effect on the ovary of the sexually inactive female English Sparrow but that depression did occur in the activated ovary. Unpublished data (Burger) for estradiol in the female Starling confirm Ringoen.

The evidence thus far does not indicate that testicular involution and in-

activity in the adult male is due to a hypophyseal inhibition induced by male or female sex hormones. The situation in the female is more ambiguous. In the Starling, the bills of both sexes darken after the breeding season, indicating a low level of male hormone. Since a reduction in day length is enough to produce testicular involution in several species, there seems no need to suppose that some inhibitor is given off by the testis. The female exhibits 2 cyclic reproductive phases: (1) seasonal gametogenesis on which is superimposed (2) shorter cycles of ovulation. The fact that egg laying can be prolonged by merely removing an egg from the nest could be taken to indicate a limited role of the sex hormones in framing seasonal rhythmicity. Avian endocrinology has developed such an extensive literature that a review of other endocrine factors can not be condensed into this summary.

Experimental Studies of Breeding

When captive wild birds are subjected to photoperiodic manipulations, the females with few exceptions fail to lay eggs, but the males form sperm. Male Starlings which have been activated by light do not attempt to copulate with females, and there is a marked failure of the sperm to leave the testis. Cole (1933) seems to have been the first to induce a captive wild bird (the Mourning Dove) to breed by the manipulation of light. Benoit (1935) secured eggs from light treated immature ducks. The Black-crowned Night Heron has been stimulated to breed in the laboratory under light treatment (G. K. Noble, personal communication). Several other species have been induced to breed by light manipulations, and numerous species have bred or ovulated spontaneously in captivity.

It has been frequently suggested that psychic factors probably are involved for those species which do not breed under experimental conditions. A striking example of a psychic factor is given by Emlen and Lorenz (1942). Sexually inactive California Valley Quail were stimulated to mating behavior, apparently through contagion, i.e. the behavior of birds treated with sex-steroids affected non-treated birds. In ornithological literature, there exists a mass of descriptive, observational, and experimental data on the supposed and actual external factors and behavioral patterns existing at the breeding season. Little information exists, however, for the whole female sexual cycle of any one species, except for the common pigeon and the domestic fowl.

Polikarpova (1940) succeeded in inducing caged English Sparrows to lay eggs. The following factors were found: "Lengthening of the daily period of light stimulates the gland of the female up to a certain stage. The presence of the active male advances the development of the sexual gland of the female by one stage. For complete maturation and for egg laying the presence of nests is necessary." (p. 95). Polikarpova's results are compressed into a short paper; the size of the cages and the nature of the nests are not given. Except

in one case, it is not clear whether the Sparrows were allowed to build their own nests, or whether they were presented with prefabricated nests.

For the female Starling, I have accumulated a good deal of experimental data. When only females are caged together, long days induce a substantial development of oocytes. As with the male, the gonads regress if the long days are continued, and regress more rapidly if short days are given. If a number of males are caged with a number of females, ovarian development under long days is no better than with females alone. Much larger oocytes (two-thirds of ovulating size) were secured under the following complex: the daily light ration was increased gradually; birds were caged in pairs; nest boxes and nest material were provided. Isolation in different experiments of the following factors indicated that each *alone* is no more effective than light alone: the presence of the male; song from males not visible to the females; nest building; daily agitation of the cloaca for 12 days; insertion in cloaca of a macerated sperm-filled testis, with or without supplementary injections of estradiol. The aerial chase preceding the natural copulation of the Starling probably makes the laboratory breeding of this bird difficult or impossible, except perhaps in a large aviary.

Glass and Potter (1944) found that reduced lighting in the spring inhibited egg laying in the Quail. Hale (1946) temporarily suppressed egg laying in the summer in the domestic hen by the use of one hour of daily light filtered through a blue glass. The depression produced by the blue filter was more marked than that produced by restricted feeding.

It should be emphasized again that egg laying or its failure gives only partial information on the condition of the ovary. Failure to ovulate may mean that only the terminal stages of ovarian activity are lacking. For example, I have caged egg laying Starlings, which on autopsy possessed full-sized ovarian oocytes. Rarely, however, did one of these females lay an egg. On the other hand, it is well known that in some species, the removal of an egg from the nest will induce the laying of an extra egg. In poultry, the disruptive effect of the cock on egg laying is well known.

Kendeigh (1941) found that House Wrens under cooler conditions produced larger clutches and larger eggs than at the peak of the breeding season. Schooley and Riddle (1944) by light were able to modify the spacing of the two eggs of a clutch of Ring-doves. Fraps, Neher, and Rothchild (1947) placed domestic hens under continuous light, and then by restricted feeding were able to control the time of ovulation. These activities, however, are terminal events which occur in a previously activated ovary. The results of Fraps, et. al. do not demonstrate that reproduction in the hen is solely conditioned by feeding time.

By the use of appropriate gonadotropins, a successful ovulation has been obtained in the hen (cf. Fraps and Riley, 1942 for details and bibliography). This is apparently the first complete ovulation secured by hormonal treatment.

A sexual difference in response to a level of gonadotropin is seen in the work of Kirschbaum, Pfeiffer, Van Heuverswyn, and Gardner (1939) on the English Sparrow. The ovary during long days remained relatively inactive, but immature testes transplanted into these females formed sperm. This may mean that the gonadotropin output under the light stimulus is the same for the 2 sexes in the Sparrow. The female may get the additional output of gonadotropins necessary for the ovarian cycle by other, non-photic stimuli (cf. Polikarpova's results). It may be that non-light stimuli can raise the gonadotropin output in the male. I have tested several times the testicular response of Starling males caged with males, and males caged with females. There seems a slight added effect produced by the presence of the female. It will be noted that in the female Starling, light alone brings the ovary up to the point of readiness for the later growth changes, i.e. perhaps to the point where additional gonadotropins that are not stimulated by light must be added. This may clarify formulations about the influence of light in the female.

Conclusions

The experimental data are yet too fragmentary to explain seasonal reproductive rhythmicity the world over, if indeed a single unified theory is possible. Genetic selection in poultry has been able to modify reproductive rhythmicity, giving evidence that natural selection has utilized the genetic variability from which species differences can be built. There is no evidence for any species of bird that its reproductive rhythmicity occurs independently of controls in the external environment. In certain species, at least, there is a difference in the factors effective in the two sexes.

All truly wild species of birds tested have been influenced to some degree by photoperiodic manipulations. How light effects pituitary stimulation is largely unknown. The theory as currently phrased, that light acts indirectly by promoting increased hypothalamic activity through longer bodily activity or wakefulness, stands "not proven". The alternative view that light acts in a less indirect fashion has more experimental substantiation, but it too is "not proven". The influence of other environmental factors beside light are most obscure. Likewise, little is known as to the relation of psychic factors to gonadal state. Most of the birds tested are native to the northern hemisphere, and either are not migrants or do not migrate deep toward the equator or trans-equatorially. Several annual spermatogenetic cycles have been produced in the laboratory for both resident and migratory birds by photoperiodic manipulations. Modification of the plumage and the testicular cycle of one tropical bird has been reported. This reviewer is not a partisan of the photoperiodic theory, he merely states that photoperiodic changes are the only widely spread factor capable of modifying reproductive rhythmicity which is moderately well-known through experimental testing.

Attention is called to the idea that in seasonally reproducing birds, sexual activation can occur only when a refractory period has been experienced and dissipated. This refractory period can be modified, in some species at least, by photoperiodic manipulations, just as the progressive phases of the cycle can be modified by light. Long days effect a persistence of the refractory phase, and short days favor its dissipation. It can be suggested that when the relation of the refractory phase to environmental conditions is understood more precisely, reproductive rhythmicity will be better understood. Attention has been focused too narrowly on the progressive phase of the reproductive cycle.

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THE LAYING RHYTHM OF COWBIRDS

MARGARET MORSE NICE

5725 Harper Ave., Chicago, Illinois

THE remarkable observations of Walkinshaw (1949) on a female Cowbird that laid 25 eggs in one season have thrown new light on the vexed question of the laying rhythm of *Molothrus ater*. Does she lay in clutches? If so, does she lay every day? What are the intervals between sets? How many eggs are laid in one season?

The 3 females observed by Friedmann laid as follows: A, 5 eggs May 23–27, 1922; B, 5 eggs, May 27–31; C, 4 eggs, May 22–25. Bird B was collected 3 days after it had laid its fifth egg and 5 discharged egg follicles were found in its ovaries. Birds A and C remained for 3 weeks longer, but no more eggs were found. From May 31 for a month and a half "it rained more or less violently every day. As fast as nests were found, they were destroyed or washed away by the heavy rains, and, of course, it became impossible to keep any check on the actions of the Cowbirds. Over a hundred nests were lost during this period, directly or indirectly due to the stormy weather," (1929:182.)

With 3 South American species of Cowbirds, Davis, (1942) reports, "A histological study of serial sections of the entire ovary of 11 specimens of *Molothrus bonariensis* and one each of *M. rufo-axillaris* and *Agelaioides badius* shows that these species lay in clutches and that the maximum number of eggs per clutch is five."

As to my own experience with Cowbirds in Columbus, Ohio, while studying Song Sparrows, I came to the conclusion that these birds laid "three (and possibly four in some cases) 'sets' of eggs with intervals of 6 to perhaps 12 days between 'sets' . . . it may well be that an egg is sometimes held over, so that 5 eggs may be laid in 6 or 7 days," (1937:155). With 3 types of eggs I found evidence of 3 sets, with 5 types of at least 2. Of type E 5 eggs were laid in 5 days; with type G 4 (at least) were laid in 5 days; with type A 4 (at least) in 7 days.

Davis (1942:10) was adverse to the idea of a Cowbird missing a day when laying. He writes, "if we assume that each female lays only five eggs in each set and lays at daily intervals, Nice's table must be rearranged, leading to the conclusion that the interval between the clutches is as short as three days." I know of no bird having an interval between clutches of less than 5 days. With passerines 5 days is the usual interval between the destruction of one set and the start of another. Riddle (1922) found that the ovum grows very slowly most of the time, but that it "jumps in a *day* from its accustomed rate of in-

crease to a rate that is probably from eight to twenty times higher. . . . The time interval between the beginning of rapid growth of the 6 mm. egg [in the fowl] and the breaking of the egg from the ovarian follicle (ovulation) is normally between five and eight days."

Near his home at Battle Creek, Michigan, Walkinshaw (1949) has been making an intensive study of Field Sparrows, color-banding the breeding birds and locating every nest. Between May 5 and July 24, 1944 he found 25 eggs that he believed were laid by one Cowbird, basing this opinion on their similarity in size, shape, and color, and on the facts that all were laid in an area of 12.5 acres and that no 2 were laid on the same day. He "knew the exact date of

TABLE I

Laying Rhythm of Cowbird at Battle Creek, Michigan, 1944

NUMBER OF DAYS		DATES LAID	NUMBER LAID
Non-laying	Laying		
	6	May 15, 16, 17*, 19*, 20	5
5			
	5	May 26, 29, 30	3†
5			
	9	June 5, 7, 10, 11, 13	5
4			
	6	June 18, 19, 22, 23	4
6			
	1	June 30	1
7			
	10	July 8, 10, 11, 14, 16, 17	6
5			
	1	July 23*	1
Total 32	38		25

* See text.

† It is possible that the Cowbird laid even more than 25 eggs, as Dr. Walkinshaw writes me that he did not find all of the Towhee nests on the area, although he believes he found all the Field Sparrow nests.

laying of 19 [of the eggs] and the date within 1–2 days for 4 others." "One nest of a Towhee was parasitized and 20 nests of 14 pairs of Field Sparrows."

From Walkinshaw's table of dates of finding of the eggs I have constructed table 1 arranged to show the laying and non-laying periods in the 70 day span.

Assuming that the 2 eggs found May 25 were laid May 17 and 19 and belonged to the first clutch, and assuming that the egg found July 24 was laid July 23, rather than on the 20th as Walkinshaw suggests, then we find that the 25 eggs fall into 7 "clutches", the first 4 ranging from 3 to 5 eggs, the sixth consisting of 6 eggs, the fifth and seventh of single eggs. The non-laying periods lasted 5, 5, 4, 6, 7, 5 days. (This arrangement gives a slightly misleading impression; for instance, there were 4 non-laying days between June 13 and 18 on which the bird did not lay, but the interval between egg-laying, which oc-

curred very early each morning, is 5 days, corresponding to the minimum reported for other passerines.)

It is surprising to note the length of the laying periods, for in all but those with single eggs, there were gaps of 1 or 2 days. It sometimes happens with other passerines that a day will be skipped, especially in unfavorable weather.

Evidence from these 4 observers shows that Cowbirds lay in clutches, 1, 2, 3, and, exceptionally, 7 in a season. (The 1 report to the contrary comes from a letter of F. L. Rand of St. Louis, Mo. to the U. S. Biological Survey in 1921, quoted by Friedmann (1929:184), telling of a hand-raised bird that laid 13 eggs in 14 days. I can find no information as to Mr. Rand's standing as an ornithologist and it is impossible to judge of the reliability of his statement.) The interval is 5 to 8 days, perhaps sometimes longer. They may lay at daily intervals, or may skip 1 or 2 days in depositing a clutch, depending somewhat perhaps on the availability of nests. Clutches probably usually consist of 4 or 5 eggs, but Walkinshaw's bird near the end of a long season had clutches of 1 and 6 eggs. As to the total number of eggs laid, this ranges from 4 and 5 with 2 of Friedmann's birds to the 25 of Walkinshaw's. It may well be that ordinarily they lay between 12 and 15 eggs.

Does a parasitic bird adjust the number of eggs laid to the opportunities presented? Chance (1940) found this to be true with the European Cuckoo (*Cuculus canorus*) by regulating the supply of Meadow Pipit (*Anthus pratensis*) nests available to the bird he watched for 5 seasons. The year when the supply was cut short she laid 15 eggs starting May 12 and ending June 13, while in the 2 years (the Cuckoo's third and fifth seasons) when Chance continually broke up Pipit nests, she laid 21 eggs from May 13 to June 27 and 25 eggs from May 11 to June 29. Cuckoos do not lay in clutches, but in a series, laying every other day, and when a regular supply of hosts is offered they lay practically continuously.

With the Cowbird, phenomenally bad weather cut off the nest supply for Friedmann's birds. As to Walkinshaw's female, it is a little hard to understand her unabated zeal for Field Sparrow nests. Usually in this area the Field Sparrow deserts when parasitized by a Cowbird. It might be thought that this response had worked as had Chance's deliberate collecting of Pipit's eggs and that the Cowbird was unduly stimulated by a continuous supply of building Sparrows. A study of the record, however, shows that this happened only with one pair, where the Cowbird laid in one nest July 8, in the substitute (and empty) nest about July 10 and in the third nest July 14.

Summary

Four observers have found that 4 species of Cowbirds lay in clutches and that the intervals between clutches last from 5 to 8 days and possibly longer. Eggs may be laid at daily intervals or 1 or 2 days may be skipped.

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GENERAL NOTES

AN EARLY RECORD AND DESCRIPTION OF THE IVORY-BILLED WOODPECKER IN KENTUCKY

The State Historical Society of Wisconsin has the Journal (Draper, Vol. 2, ZZ) of Col. William Fleming. He gives a description (pp. 12–13) of the Ivory-billed Woodpecker (*Campephilus principalis*) which is much more detailed than that of Mark Catesby (Natural history of Carolina, Vol. 1. London, 1731:16). The Journal was printed by Newton D. Mereness (Travels in the American Colonies. Macmillan, N. Y., 1916:632). While purporting to be a faithful copy, comparison with the original shows that several words, in one case a sentence, were omitted.

Fleming, born in Scotland on February 18, 1729, was educated as a surgeon at Edinburgh. In 1779 he was a member of the Virginia Commission sent to Kentucky to settle land claims. St. Asaph's, or Logan's Fort, was situated one mile west of modern Stanford, Lincoln County. There are very few definite records of this woodpecker for the state. The Journal contains the following entry:

March 7, 1780. "Rode up to St. Asaphs from Col. Bowmans, I observed a species of the woodpecker which I had not met with before, the Cock and the hen, they are larger than the large brown [juvenile pileated woodpecker?], the cock had a bright red head with remarkably long tuft of feathers on the Crown so that it may be cald the Peacock Woodpecker the body & wings white & black, the hen darker colored the bills of both a great length & white.

"One of these birds was shot by my servant, which I took to be the hen, the feathers on the throat and belly and part of the wing and tail a shining black, it had nine stiff & strong feathers or pinions in the tail forked at the end, the midle one being six inches long from where the feathers begin the whole length being 7½ inches the others on each side shortened in length, its wings ten inches long from the shoulder to the tip 18 long feathers in the wing, the two first and longest black the 3rd tip'd with white and each succeeding one more till those next to the back are all white, both above & below, the front & fore part of the Crown black, from the junction of the upper & lower bills white feathers on each side, leaving a triangle of black feathers from the Eyes and back part of the Crown which is a deep red, the white feathers run backwards as far as the white on the wings intermixed with black so that the bird from the head so far appears speckled, the red part of the crown appears triangular, its legs was an inch & half long, with four toes set forwards & back two each way, armed with strong crooked claws, the two outer ones the longest & 4 inches in length [spread?]- the bill white and bony, verry strong & firm at the point shaped like a wedge each ⅛ of an inch broad and from that a ridge runs both in the upper and lower so that each forms a triangle an inch & quarter broad at the Junction of the upper and lower bills, which is three inches in length, the tounge is six inches in length. The Iris when dead of a bright Yellow so far it differs from any of the species I have seen, the mechanism of its parts being as usual in birds of this kind, it weighed upwards of 1 lb."

The error in sex is obvious.—A. W. Schorger, 168 N. Prospect Ave., Madison, Wis.

WOODCOCK AT SEA

On July 6, 1949, at 7:30 A.M., an American Woodcock (*Philohela minor*) alighted on the flight deck of the airplane carrier U. S. S. Midway at 39° 55′ N, 70° 05′ W. This point is 82 miles due south of Nantucket Island, the nearest land, and 108 miles southeast from Montauk Point, Long Island. Only one bird was observed. It flew alongside the ship, attempting to alight for approximately 15 minutes before it succeeded. The flight of the woodcock suggested

fatigue but it kept up with the ship with little difficulty. The weather had been overcast for the preceding 12 hours; at this time additional fog and haze were on the surface, and an 8 knot wind was blowing. The ship was on course 223 and steaming at 17 knots. The bird was on deck for only 45 seconds when it was frightened away. It flew alongside for several minutes again attempting to land, but was unsuccessful. Another large carrier was approximately 2,000 yards abeam, and when last seen the bird was headed in that direction.—WALTER ROSENE, JR., Fish and Wildlife Service, Gadsden, Alabama.

LITTLE GULL AT COLUMBUS, OHIO

On March 22, 1949, at O'Shaughnessy's reservoir, north of Columbus, we had the good fortune of observing a Little Gull (*Larus minutus*). The bird, an immature, was standing in the shallow water at the margin of a small bay, in company with an immature Bonaparte's Gull (*L. philadelphia*) and eight Ring-billed Gulls (*L. delawarensis*).

We were able to observe the bird through 8× and 10× binoculars and a 20× telescope at a distance of 200 feet over a period of 15 minutes. It was much smaller than the neighboring Bonaparte's and its beak was shorter and smaller. It showed the characteristic dusky nape, as contrasted with the spot behind the eye of the Bonaparte's. Several times when it stretched its wings we were able to see the dark streak down the wing and the black primaries. Its tail had a black subterminal band.

This appears to be the first reported occurrence of this species for Ohio away from Lake Erie.—MARIAN W. THOMAS AND ELDER P. HENGST, Columbus, Ohio.

MOCKINGBIRD IN THUNDER BAY DISTRICT, ONTARIO

On July 20, 1948, while in the grounds of the Mental Hospital, about 5 miles west of Fort William, Ontario, our attention was attracted by an unusual song, shortly followed by the clearly enunciated call of the Whip-poor-will. Our suspicions were immediately aroused, and although the bird was extremely restless, constantly flying from tree to tree, we were eventually able to get a good view and to identify it as a Mockingbird *Mimus polyglottos*. This is unusually far north for this species, and constitutes, we believe, the first record for this district.—A. E. ALLIN AND L. S. DEAR, P. O. Box 127, Port Arthur, Ontario.

A WINTERING CHAT IN SOUTHEASTERN MICHIGAN

On Jan. 26, 1949 a Yellow-Breasted Chat (*Icteria virens virens*) was found fluttering around in a garage. An item in the local press brought a phone call from a feeding station operator, by the name of H. Crain of 220 McKinley, Grosse Pointe, who reported he had been seeing the chat at his feeder since the first of the year. The specimen was sent to the University of Michigan Museum of Zoology. H. B. Tordoff determined that the specimen was referable to the race *virens*, and offered the following comments: "It is, as far as I can tell without an exhaustive check of the records, the first occurrence of the species in Michigan in winter. The specimen was a male, in fine plumage. There was some fat, so obviously it had been getting enough to eat. It weighed 26.6 grams, an entirely normal weight. I would say that the bird was in good general physical condition. However, there was an irregular tail moult in progress, and this may have been the result of a former injury. Perhaps the specimen was injured by a car, or in some other way and did not make the fall migration."—CLARENCE J. MESSNER, 308 McKinley, Grosse Pointe 30, Michigan.

LITERATURE

Comments on Recent Literature

"Swallows certainly sleep all the winter. A number of them conglobulate together, by flying round and round, and then all in a heap throw themselves under water, and lie in the bed of a river."
Dr. Samuel Johnson.

Accounts of hibernating birds, though circulated since the time of Pliny, have found little favor in scientific circles. Hence the recent discovery that the Poor-will, *Phalaenoptilus nuttallii*, sometimes does hibernate came as a great surprise. Culbertson (1946) found a torpid Poor-will half buried beneath a pine limb on the ground near Fresno, California. This was on February 6, following a month in which the temperature had dropped below freezing almost every night. Stressing the improbability that the bird had been able to feed during this period, Culbertson suggested that hibernation might be involved. A year or two later, Jaeger (1948, 1949) during a visit to the Chuckawalla Mountains in the Colorado Desert found a dormant Poor-will nestled within a niche in a canyon wall. This bird was banded, photographed, and periodically examined during 3 successive winters, which it spent in the same retreat. Its body temperature ranged from 18.0–19.8° C. (about 66° F.). This was about the same as the surrounding air temperature but far below the usual body temperature of birds. Since the basic feature of hibernation is the transformation of a normally warm-blooded animal into a cold-blooded one (Suomalainen, 1940), the winter dormancy of the Poor-will may be considered true hibernation.

Jaeger found the wintering Poor-will to be in a generally low state of metabolism. Usually it gave no response when handled or even when a flashlight was shined directly into its half-open eyes. No chest movements or heart beat could be detected with a stethoscope. Even a driving sleet storm did not cause the bird to move, although its plumage was considerably battered. During the only winter of complete observation (1947–1948) Jaeger is certain that this Poor-will was in "profound hibernation torpidity" from on or before November 26 until shortly after February 14. It survived and was back in its "hibernaculum" on November 24, 1948.

There is little good evidence of migration into Mexico by Poor-wills. Some winter records for the United States, however, are of normally active birds. Whether the birds of the Great Basin usually migrate or whether they hibernate is unknown, but there is some reason to believe that hibernation may occur there as it does in California (Jaeger, 1949).

McAtee (1947) recently published an annotated bibliography on torpidity in birds. No convincing evidence of hibernation is presented for any other species. There is, to be sure, a detailed account of hibernation by Chimney Swifts, *Chaetura pelagica*, quoted from a "recognized ornithologist," but unfortunately one recognized chiefly for his unreliability. Hanna (1917), however, found that inclement weather may induce White-throated Swifts, *Aëronautes saxatalis*, to remain in their rocky retreats for several days. After a cold snap some of these swifts were brought to him in a torpid condition. European Swifts *Micropus apus*, bunch together in large masses to conserve body heat when a prolonged spell of cold rainy weather prevents them from feeding (Kuhk, 1948), but under such conditions heavy mortality begins almost immediately. Temporary lethargy, usually as a result of chilling, has been reported in a number of other species, notably hummingbirds, but there is no reason to believe it does not lead to death in a few days at most if the birds are not revived. Nevertheless, such physiological tolerance of chilling probably made possible the development of longer periods of inactivity in the Poor-will.

Brief torpidity, though known from comparatively few species of birds, is perhaps possible in many others under certain conditions. The following incident, related to me by Dr. James P. Chapin, tends to confirm this: "In 1910 Herbert Lang and I were encamped in a remote part of the northeast Congo forest gathering material for an Okapi group. From time to time natives would bring us a supply of live chickens to be dispatched as needed for the table. On one such occasion the boys were caught in a torrential downpour accompanied by a sharp drop in temperature. When the party finally arrived in camp, the chickens were found piled up in the bottom of the carrying-basket, drenched and to all appearances dead. The natives, who obviously knew their chickens better than we did, placed them on their sides around the camp fire. After a few minutes they turned them over to warm the other side. Before long some signs of life appeared, and soon all but one of the chickens were running about normally."

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DEAN AMADON

Book Reviews

Nature and Its Applications. By Jessie Croft Ellis. (F. W. Faxon Company: 1949) 7 x 10½ in., xii + 861 pages, $17.00.

This large volume will serve as a valuable tool for ornithologists who must search through literature for references to particular species of birds. In brief, it is an index to illustrations (*i.e.*, reproductions of photographs, drawings, paintings, etc.) of various nature subjects ranging from Aardvarks to *Zygadenus elegans*. An attempt is made to include "not only subjects of nature in their natural setting and form but also nature as used in art, sculpture, advertising, paintings, toys, and every form of decorative design work." Persons using this index will find that it is possible to obtain much written information about the subjects included since illustrations are accompanied occasionally by explanatory legends and frequently by articles relating to them.

Over 125 books and periodicals have been indexed. These include *Audubon Magazine* (also its predecessor, *Bird-Lore*) and *Nature Magazine* which have regularly published extensive information on birds, as well as the following which have on numerous occasions carried information useful to persons interested in birds: *American Forests, Field and Stream, National Geographic Magazine*, and *Natural History*.

The present work is a new edition of "Nature Index" by the same author and is limited to 1,000 copies. Both the author and publishers are to be commended for having performed this great service to workers in the field of natural history.

Olin Sewall Pettingill, Jr.

The Birds of Concord. By Ludlow Griscom. (Harvard University Press: 1949) 340 pages 16 illus., 1 map. $5.00.

In this book, the most expert field ornithologist of our generation compares his notes with those of William Brewster, the most expert of the preceding generation. The result is a treasure of data concerning changes in the avifauna of the region around Concord, Mass. The introduction describes the Concord area, summarizes the ornithological work and explains the study methods. Brewster in 1868 began recording observations of birds at Concord in voluminous diaries and notebooks. Griscom has abstracted these and added his own recent notes. Part I of the book, titled Population Trends, describes the basic ecological factors of the region and of the birds. Then follows a summary of fluctuations in animals and a description of the increases and decreases in populations. Part II describes the present bird life and gives in a systematic list the abstracted notes of Brewster and others.

For the general ornithologist by far the most important sections deal with the changes in abundance of a number of species (p. 97–132). For example, the Indigo Bunting was common from 1830–1879, declined from 1880–1930, and subsequently increased. The Nighthawk not only fluctuated in abundance but also changed from nesting on the ground to nesting on the roofs. The spectacular results of protection of Wood Ducks and Egrets are clearly shown by the records for 100 years. Perhaps the most significant parts are the discussion of Brewster's principle of population overflow and the estimates of populations at Hurd's Pond, Wayland.

While these histories of populations are fascinating, the critical ornithologist will be concerned at the superficiality of the discussion of results. Terms such as Gaussian curve, periodicity, capacity, etc. are loosely used. Furthermore, the author, who is also an expert botanist, could have given a more specific description of the vegetation, citing the numbers and kinds of plants. The discussion of cycles (p. 123) shows an amazing lack of understanding of cyclic phenomena. The words density (birds per unit) and population (total birds) are frequently confused. Lastly, the illustrations are excellent photographs (none by the author) but do not

illustrate the book; a picture of hundreds of Snow Geese is inappropriate as an illustration for an area reporting only 84 geese in a century! A Bald Eagle on its nest is similarly inappropriate. While the Concord ornithologists will find this book of immense value, its numerous deficiencies will tantalize the serious ornithologist.

DAVID E. DAVIS

Birds of Prey of Northeastern North America. By LEON AUGUSTUS HAUSMAN. (Rutgers University Press: New Brunswick, N. J.: 1948.) xxv + 164 pages, 31 ill., 1 col. plate. $3.75.

In an attractive format and at a price which is, for these days, quite reasonable, the rather suddenly prolific Dr. Hausman gives us a book which is a pleasant introduction to the birds of prey. For each of 35 forms a short description is given of adults and young with measurements of body length and wingspread. This is followed by a discussion ranging in length from a few paragraphs to a few pages. For the falconiforms a list of common names other than the accepted ones is provided. Besides the specific or subspecific accounts there are general discussions of the vultures, the hawks, the eagles, the falcons and the owls. Illustration plays a prominent part in the book and consists of a colored frontispiece by Sutton and 31 full-page drawings by Abbott. There is a systematic appendix, a bibliography, and an index of names.

The book presents a pleasing appearance. There is good spacing, wide margins, and clean printing; the page-size is large (7 x 10 in.); the binding is tasteful. From the initial paragraph of the book, the author maintains a sympathetic attitude toward the birds of prey. He points out that many birds, including the most of our admired song birds, prey upon other forms of animal life. The appeal of hawks, eagles, and owls to the aesthetic sense is constantly brought brought before the reader, and the role of the predator in maintaining healthy populations of useful prey species is not neglected. The writing is lucid and adequate to the purpose.

In this book exhortation and reasoning take the place of documentation and numerical data; tables of figures are never allowed to mar the pages, though poetry finds a place. The only major typographical error is the misuse of the subspecific name of the Northern Bald Eagle. More serious is a curious confusion between species and subspecies (p. 86). The appendix giving the classification seems unnecessary padding in view of the systematic arrangement of the body of the book; it merely copies the names of the 1931 Checklist without regard to the supplements, and commits several errors in the copying. The illustrations are adequate, though the use of brown ink in reproducing them reduces the sharp contrast which is one of the chief glories of pen and ink work. In some instances the choice of prey shown in the illustrations seems unfortunate from the viewpoint of the author's emphasis. While the text stresses other prey, the Red-tailed Hawk is shown with a rabbit, the Swainson's Hawk with a squirrel, and the Rough-legged Hawk with a muskrat, all favorably regarded animals.

Subject to the limitations of its aim and scope, this book can be recommended to the general reader and seems particularly suitable for school libraries.

HAVEN KOLB

Audubon's American Birds. By SACHEVERELL SITWELL. (B. T. Botsford: 1949) 12 pages, 16 plates. $2.00.

This volume is in the same series as *Tropical Birds* and reproduces excellently plates (9.5 x 7.5 inches) of the Wild Turkey, Baltimore Oriole, Carolina Paroquet, Florida Jay, Collie's Magpie-Jay, Pileated Woodpecker Meadowlark, White-Crowned Pigeon, Wood Duck, Wood Ibis, Mallard, American Eider, Roseate Spoonbill, Scarlet Ibis, Woodpeckers, Flamingo. One wonders why these particular plates were chosen. The 12 pages of comments are a horrible miscellany of irrelevant matter written in endless sentences which leave the reader thoroughly bewildered. For example, why include nearly 2 pages of names of races of fighting cocks. It

is a pity that the publishers did not ask one of the many capable English ornithologists to write the notes.

DAVID E. DAVIS

Blackie and his Family. By M. E. COOK. (Harcourt, Brace and Co.: 1949) 69 pages, illus. $2.00.

This review of a book for children is included in the Wilson Bulletin because it is believed that ornithologists are probably teaching their children about birds. Your editor will appreciate comments from the members concerning the desirability of reviewing children's books.

Blackie (apparently a Brewer's Blackbird) and his wife Dusty lived in a garden and built a nest in a pomegranate. They successfully repelled Mr. Darting Hawk, Chucky Ground Squirrel, and Old Man Gopher Snake. After raising 4 young, the birds join a flock and eventually migrate. Ornithologically the book is satisfactory. There are no serious errors in life history data and the anthropomorphism is not excessive although (p. 4) the function of song has the erroneous poetic interpretation. Conservationists will regret the emphasis upon the hawk episode. From the viewpoint of a psychologist the book is satisfactory but not impressive. Children from 5–8 will enjoy a couple of readings. Unfortunately, the hawk and snake episodes are likely to make the greatest impression. Ornithologists have discovered a gold mine in adult books. Why shouldn't they invade the field of children's books and teach our children correct ornithology?

DAVID E. DAVIS

W. E. Saunders, Naturalist. Edited by R. J. RUTTER. (The Federation of Ontario Naturalists, Toronto: 1949) 6¼ x 9 in., 66 pages, 5 photos, cloth.

This is a tribute to Saunders the man, by those who knew and loved him in his native Southern Ontario. His enthusiasm for and his interest in all about him, extended to music, horticulture, town planning, conservation, insects, mammals, birds and his fellow men. He taught practical chemistry at one time; carried on his vocation, pharmaceutical manufactory; for years wrote a weekly newspaper column; and delighted to talk and lecture about his interests. Included in this volume are samples of Saunders' writings, appreciations by P. A. Taverner, J. R. Dymond and J. L. Baillie, and Baillie has provided a 13 page bibliography of Saunders' writing.

A. L. RAND

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The following gifts have been recently received. From:

Hilda F. Amidon—2 reprints
Ralph Beebe—8 magazines, 3 books
Hervey Brackbill—7 reprints, 2 books
G. Reeves Butchart—1 reprint
Robert D. Edwards—1 reprint
Herbert Friedmann—6 reprints
Fr. Haverschmidt—2 reprints
Harold M. Holland—4 books
Leon Kelso—1 pamphlet
S. Charles Kendeigh—4 reprints
Haven Kolb—20 magazines
Margaret M. Nice—17 reprints, 2 magazines, 1 book
Eugene P. Odum—2 reprints
Kenneth C. Parkes—4 reprints
William H. Phelps—2 reprints
N. S. Potter, III—1 reprint
Richard W. Russell—1 book
Gordon C. Sauer—1 magazine
Johann Schwartzkopff—2 reprints
Robert W. Storer—1 reprint
J. Van Tyne—12 reprints
University of Wisconsin Department of Wildlife Management—4 reprints

To the Members of the Wilson Ornithological Club:

THE OFFICERS OF YOUR CLUB are very desirous of increasing the Endowment Fund of the organization in order to secure an ample permanent income.

Due to higher costs of printing, postage, secretarial service, etc., the revenue received from membership dues is not adequate to carry on the expanding activities of the Club. As you well know, the *Bulletin* is the most valuable asset of the Club, and it could be increased in size, with more photographs and an occasional color plate, if funds were available. There are many other services and research projects that could be amplified if the means were at hand.

The interest received from the monies invested has been increasing slowly each year as the Endowment Fund has grown. It is our hope to build this fund as rapidly as possible. This may be accomplished by three methods:

1. From receipts of Life Memberships, which have been allocated to this fund. A payment of $100.00 at one time, or 4 annual installments of $25.00 each, entitles one to Life Membership, with exemption from further payment of dues. This method should appeal to every younger member who can possibly afford it. Won't you seriously consider taking this step?

2. From outright gifts, either from yourself over and above the payment of your regular membership dues, or from friends whom you might interest in our cause.

3. From bequests. Many of you have devoted years to ornithology, as a hobby or as a vocation. Isn't it logical then to perpetuate your interest by leaving some sum to the Club on your death? We hope that you will take steps promptly toward such a bequest.

We urge you to contribute to the extent of your ability so that *your* Club may grow in its value to you and to society in general.

THE ENDOWMENT FUND COMMITTEE
Clinton S. Banks
Robert L. Edwards
Robert T. Gammell
Robert A. McCabe
Leonard C. Brecher, *Chairman*

THE PRESIDENT'S PAGE

Many of our Wilson Club members keep records of their field trips for birds and take notes on their observations of behavior, habits, ecological relationships, and other aspects of bird-life. In respect to these tasks, the following question occurs to me: Are the records and notes being carefully organized and conveniently filed for immediate reference? Or, to put the question another way: Are the notes and records being accumulated in such a manner as to make them useful not only to persons performing the tasks, but also to persons who may eventually have access to them?

No two ornithologists hold identical interests; it can, therefore, be expected that their records and notes are slanted in different directions. Basically, however, their information must be accumulated and kept in a systematic fashion, if it is to be of lasting value. Let me point out the methods of two ornithologists well known to this organization.

Mr. Ludlow Griscom is engaged in the study of bird distribution, migration, and populations. While on field trips he is constantly looking for evidences and explanations of range extensions, migration irregularities, population increases and declines, and seasonal variations. He has a daily record book in which he enters the temperature, wind velocity, and sky conditions of each day, whether it is a field trip day or not. Thus he can quickly reconstruct the weather history of a particular season. In this same book he also enters a brief account of each field trip, the list of birds seen, and careful counts, or estimates, of the number of individuals of each species. In addition, Mr. Griscom has a series of loose-leaf ledgers in which all North American birds are arranged in phylogenetic order. In it, his observations are recorded under each species by year and states. From these ledgers it is a simple matter to obtain the data for any particular species or area that interests him at the moment.

Dr. George Miksch Sutton, being a bird artist, is constantly studying the attitudes and behavior of birds; furthermore, he is always observing the habits and ecological relationships of birds in specific localities. When working in the field he keeps a journal in which, at each day's conclusion, he notes significant weather conditions, gives descriptions of the area covered, and puts down his impressions of habitat relationships. He also has at hand a loose-leaf notebook, one page to a species, arranged in chronological order (*i.e.*, the order in which each species is first seen). After each day's trip, he goes through the notebook, writing down the number of individuals of each species counted and giving terse accounts of nests, their contents and location, of flight peculiarities, of songs and call notes, of feeding habits, of defensive reactions, of instances of predation. When Dr. Sutton is through working in the field and returns to his office, the journal is filed away by year, but the loose-leaf notebook is treated differently. Species pages are rearranged in phylogenetic order, numbered, and indexed. The species pages are then disassembled and filed in folders, one to a species; the index is placed in a folder with indices from earlier notebooks. This system keeps together in one folder all species data gathered by him through the years, while at the same time permitting, by means of the indices, the reassembling of species pages resulting from a particular trip.

I sincerely hope that Wilson Club members handle their records and notes in an equally efficient manner so that the information will be useful to them in their lifetimes and to future bird students. William Brewster, one of America's greatest ornithologists, painstakingly obtained and methodically preserved a mass of information on the New England birds of his day. Now long after his death, we have an accurate, readily available picture of an avifauna that has since become modified.

OLIN SEWALL PETTINGILL, JR.

ANNOUNCEMENT OF ANNUAL MEETING

NOTE: This is the official announcement of the annual meeting. In previous years the announcement has been issued in the form of a letter from the Secretary, mailed individually to members.

Place and Time. The Thirty-first Annual Meeting of the Wilson Ornithological Club will be held at Jackson's Mill, West Virginia, Friday and Saturday, April 28–29, 1950. On Thursday, April 27, there will be a meeting of the Executive Council, and on Sunday, April 30, there will be organized field trips.

Jackson's Mill and How to Reach It. Jackson's Mill is the site of the West Virginia 4-H Camp, a nationally known youth center and meeting place. The Camp has some thirty permanent buildings, on a tract of five hundred acres. It is four miles north of Weston, and twenty miles south of Clarksburg. It is reached by surfaced highway, which leaves U. S. Route 19 near the city limits of Weston. At Jackson's Mill "Stonewall" Jackson lived as a boy, and the old grist mill built by his grandfather is still standing.

Attractions. It would be difficult to imagine a more pleasant place for a meeting than the southern Appalachians in late April. Jackson's Mill is in hilly wooded country just west of the Allegheny ridges. Redbud and early dogwood should be in bloom along the roadsides, and there will be much of outdoor interest. Depending somewhat on the season, there should be heavy migration of birds at this time. At the Camp, field trips begin at your cottage door. The group in attendance will live and dine together, with no outside distractions. Plans for the meeting include a series of papers on birds of the Appalachian region on Friday afternoon, an informal gathering after the Annual Dinner on Friday evening, and a motion picture session on Saturday afternoon. On Saturday night Mr. H. P. Sturm will show his outstanding color film, "Wild Flowers of the Alleghenies".

Sessions. Sessions will begin at 9:00 a.m. and continue until about 5:00 p.m. Daytime meetings will be in the Century of Progress Building. Night meetings will be in the Assembly Hall.

Special Events. After the Annual Dinner on Friday evening the host organizations will welcome members and guests at an informal reception and entertainment at the Assembly Hall. There will also be an informal gathering on Saturday evening. A small exhibit of Southern Highlands handicraft articles, weaving, wood carving, hand-made jewelry, etc., will be available at the Camp. On Saturday after supper a tour of the Camp grounds, with a chance to visit the old Jackson mill, will be conducted.

Meeting of the Council. The Executive Council of the Wilson Ornithological Club (all officers, all past-presidents, and three elected members) will meet on Thursday, April 27, at 4:00 p.m. in the lobby of Harrison Cottage. This

meeting will continue through the evening. The Secretary requests that chairmen of committees send their written reports to him by April 15, in order that these reports may be discussed by the Council.

Accommodations. All members and guests will be housed in comfortable cottages at the Camp. Most of the cottages have dormitory type sleeping quarters, with single beds. There are about twenty-five units suitable to family groups. The Camp is a pleasant place for small children, and early reservation will insure the care of family parties in these units.

Meals and lodging at the Camp from dinner Thursday evening through breakfast Sunday morning will cost $11.43, with prices for shorter times correspondingly less. This rate includes the Annual Dinner, separate tickets for which will cost $2.75. The rates for individual meals (excluding the Annual Dinner) are breakfast, 65 cents; luncheon, 75 cents; and dinner, $1.25, plus state sales tax. Lodging is charged for at the rate of $1.25 for the first night, 75 cents for the second night, and 50 cents for the third night, all prices plus 2% state sales tax. All meals are served in the Mount Vernon Dining Hall.

The Camp furnishes all bedding. Visitors may bring their own towels and soap, or may secure them at the Camp Office for a small additional charge.

Sports or field clothing will be entirely suitable for all functions at Jackson's Mill. The weather may be cool, and rain clothes should be provided for.

To assist the local committee in planning your accommodations, it is urgently requested that you make advance registration, as early as possible, through Maurice Brooks, West Virginia University, Morgantown, West Virginia. Please state the approximate time of your arrival and departure, and the names of persons in your party.

Transportation. For persons driving to the meeting, Jackson's Mill is reached by marked highway from U. S. Route 19 near the city limits of Weston. Interurban busses which stop at the Camp leave Clarksburg and Weston every hour and one-half during the day. Clarksburg is on the main line of the Baltimore and Ohio Railroad between New York and St. Louis, about midway between Washington and Cincinnati. It is on U. S. Routes 19 and 50, and is served by Greyhound, Blue Ridge, Reynolds, and West Virginia Transportation Company busses. It is a stop for Capital Airlines between Pittsburgh and points south. For private planes there is an excellent landing field on the Camp grounds at Jackson's Mill.

Persons with heavy baggage or other transportation problems may arrange through the local committee to be met in Clarksburg or Weston. All mail, express, telegrams, and telephone calls should be addressed care of the State 4-H Camp, Weston, West Virginia.

Field Trips. There will be a choice of two field trips, both by private cars, on Sunday, April 30.

1. *Cheat-Gaudineer region.* This trip will be into the spruce-clad mountains

at elevations above 4,000 feet. Here the plants and animals are quite boreal, and many northern birds reach their southern breeding limits. Of special interest to those from lowland regions.

2. *Holly River State Park.* This trip is designed for those more interested in Carolinian birds—Blue-gray Gnatcatchers, Carolina Wrens, Hooded and Kentucky Warblers, Summer Tanagers, White-eyed Vireos, Bewick's Wrens, and others. Swainson's Warblers breed in the park, and *may* have arrived at the time of the field trip.

Both trips will leave Jackson's Mill at 8:30 a.m. and permit return by 5:00 p.m.

Hosts. Host organizations for the meeting are the Brooks Bird Club and the Huntington Bird Study Club. The local committee in charge of arrangements is as follows:

MAURICE BROOKS, *Chairman*

I. B. BOGGS	JAMES T. HANDLAN
VIRGINIA G. CAVENDISH	MRS. JOHN W. HANDLAN
CHARLES CONRAD	C. O. HANDLEY
W. R. DEGARMO	EVA HAYS
RALPH EDEBURN	W. C. LEGG
N. BAYARD GREEN	M. GRAHAM NETTING

APPLICATION FOR A POSITION ON THE PROGRAM

Members who have conducted research as yet unpublished or who have movies or slides of special interest, are urged to write for a place on the program. Papers will be selected for their timely interest and their contribution to ornithology. In making these selections, the Secretary will be assisted by the Local Committee and by the other officers of the club. If you do not have anything to present yourself, perhaps you may be able to suggest outstanding papers which the Secretary can secure for this meeting.

If you would like to appear on the program at Jackson's Mill, please write to the Secretary, Harold F. Mayfield, 2557 Portsmouth Avenue, Toledo 12, Ohio, not later than March 1, 1950.

Please note that no more than one paper may be presented by any one member. A paper accompanied by motion pictures must not exceed 30 minutes; a paper accompanied by slides must not exceed 20 minutes; a paper without pictures must not exceed 15 minutes. A limited time for discussion will be allowed following each paper.

In writing the Secretary, please supply *all* of the following information applicable to your paper:

Title of Paper. Give title exactly as you want it to appear on the program.

Abstract. Please give an abstract of your paper—brief, but sufficiently com-

plete so that the local committee may use it for publicity and the Secretary may use it in preparing the proceedings of the meeting.

Time Required.

Position. State if it is essential that you appear at a particular time.

Special Equipment Needed. Blackboard, map hanger, pointer, etc.

Movies. If your paper is to be illustrated with motion pictures, please give the following information: Size (16 mm or 35 mm). Color or black and white. Total footage. Number of reels. Size of reels.

Slides. If your paper is to be illustrated with slides, please give the following information: Size (3 1/4″ × 4″, or 2″ × 2″). Color or black and white. Number of slides.

Name. Please write your name exactly as you wish it to appear on the program. Titles before names will not be used.

Address. Include the name of the institution with which you are associated, if any. The name of this institution will be used after your name on the program.

Suggestions to a Member Presenting a Paper

To assist members in planning their presentations, we offer the following suggestions:

1. A paper should be prepared to come within the time allotted. If your paper runs overtime, you place the presiding officer and possibly the later speakers in an embarrassing position.

2. The paper should contain a concise statement of the problem and the scope of the investigation. A brief summary is important, but a long list of conclusions usually is not necessary.

3. A person giving a paper for the first time is especially advised that very few people are able to keep an extemporaneous address (with or without notes) within the time limit designated. It is ordinarily more satisfactory to prepare a manuscript and to read it slowly in a moderately loud voice. On an average, two minutes are required to read a double-spaced, typewritten page. Fifteen minute papers, therefore, should not be over seven and a half pages in length.

4. A person presenting either motion pictures or slides, or both, must include the time required for showing them in the request for time on the program. Generally, four and one-half to five minutes are necessary to show one hundred feet of 16 mm film at normal speed, while between three and four minutes are necessary for a projectionist to change reels. About one minute is needed to show a picture slide and make a brief comment on it; more time is required for explaining a slide showing a chart, graph, or diagram.

5. When presenting motion pictures or slides, please consider these suggestions: See the projectionist well in advance of the time for your paper, and

explain the order in which the films or slides are to be shown. All reels should be numbered; all slides should be in correct order, thumb-marked. Do not continue a slide on the screen after you are through talking about it. Either signal the projectionist to turn on the auditorium lights, or to turn out temporarily the light in the projector. Visit the speaker's platform before the session begins and learn the position of the signals, how the signals are used, where the pointer is kept, where the speaker's light is located, and how it may be turned on and off.

LIFE MEMBER

LEONARD C. BRECHER began his acquaintance of birds during his boyhood, and has devoted 35 years to their study—as an avocation. He received an M.S. degree from the University of Louisville, but, instead of following the biological sciences professionally, he joined his father in the manufacture of furniture. He is a member of various scientific societies, and president of Kentucky Ornithological Society. At present he is fieldnotes editor of its journal "The Kentucky Warbler", to which he has contributed a number of articles from time to time. He is now chairman of the Endowment Fund Committee of the Wilson Ornithological Club.

WILSON ORNITHOLOGICAL CLUB NEWS

President Pettingill has appointed the following Nominating Committee to prepare a slate of officers to be voted on at the Annual Meeting in April: R. Allyn Moser, Chairman, S. Charles Kendeigh, and A. W. Schorger. Members are asked to send their suggestions to this Committee.

Barro Colorado Island—Information Wanted

An annotated list of the birds of Barro Colorado Island, Panama Canal Zone, is in preparation. Information is sought bearing on status, distribution and nesting dates. Particularly useful would be additions to or comments on the list appended to Chapman's "Life in an Air Castle", 1938. Eugene Eisenmann, 11 Broadway, New York 4, New York.

Louis Agassiz Fuertes Research Grant

Applications for the 1950 Louis Agassiz Research Grant are now being received by the chairman of the Grant Committee, Dr. Charles G. Sibley, Department of Natural Sciences, San Jose College, San Jose, California. Information concerning the grant may be obtained from the June 1948 *Wilson Bulletin*. Details and application blanks may be obtained from the chairman. Applications should reach the chairman before March 15, 1950.

Ornithologie Als Biologische Wissenschaft

This special volume was published on November 22, 1949, on the occasion of the sixtieth birthday of Erwin Stresemann. It includes among its twenty-eight contributors J. Berlioz, J. P. Chapin, J. Delacour, R. Drost, F. Goethe, O. Koehler, G. Kramer, H. Laven, K. Lorenz, E. Mayr, W. Meise, A. H. Miller, R. E. Moreau, R. C. Murphy, M. M. Nice, P. Palmgren, E. Schüz, H. Sick, N. Tinbergen, H. O. Wagner, H. Weigold, and E. Witschi. Papers in English, French, and German deal with all phases of ornithology: systematics, speciation, general evolution, ecology, zoogeography, embryology, and the study of behavior. This collection of important original papers belongs in the library of every ornithologist.

The price for the bound volume of 350 pages is $5.50. A special price of $3.50 will be allowed to members of the Wilson Ornithological Club provided their orders are received before March 1, 1950. All orders should be addressed to Dr. E. Mayr, American Museum of Natural History, New York 24, New York.

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DAVID E. DAVIS

615 N. Wolfe St.

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